**REMARKS**

Claims 1 to 20 are all the claims pending in the application.

Claims 1, 3, 4 and 19 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent App. No. 2003/0219630 Al to Moriwaki et al, alone or further in view of "Applicants' admissions."

Applicants submit that Moriwaki et al and applicantsl alleged admission do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

The present invention as set forth in claim 1 as amended above is directed to a perpendicular magnetic recording medium comprising a substrate, at least one underlayer formed above the substrate, and a perpendicular magnetic recording layer formed above the at least one underlayer. An easy magnetization axis of the perpendicular magnetic recording layer is oriented perpendicular to the substrate. The perpendicular magnetic recording layer includes magnetic crystal particles and grain boundaries surrounding the magnetic crystal particles, wherein the grain boundaries contain an oxide of silicon and at least one element selected from the group consisting of Li, Na, K, Rb, and Cs. The ratio of a total amount of substance of Si, Li, Na, K, Rb, and Cs in the perpendicular magnetic recording layer is no less than 1 mol% and no more than 20 mol%.

Thus, applicants have amended claim 1 to require the use of alkali metal oxide in the grain boundaries in the perpendicular magnetic recording layer in addition to an oxide of silicon.

An oxide of at least one element selected from Li, Na, K, Rb and Cs is a low melting oxide which can decrease the glass transition temperature of the SiOx.

Thus, in one aspect of the present invention, a perpendicular magnetic recording layer is formed comprising magnetic crystal particles, and as a grain separating material at least one low melting oxide of Li, Na, K, Rb and Cs in addition to $SiO_2$ as a grain separating material.

When a complex oxide, such as $SiO_2$+$Li_2O$, is used as the grain separating material in the magnetic recording layer, the signal noise ratio of medium (SNRm) and a full width at half maximum of differential waveform (dPW50) (as an indicator of recording resolution) of the magnetic recording medium are quite improved as compared to the case of using only $SiO_2$, as shown in Table 1 and page 19, in the paragraph after the Table 1 of the present specification. This shows that the mixed oxides are not functionally equivalent to a single oxide in the magnetic recording layer.

In addition, the present specification discloses, as shown in Fig. 4 and on page 19, last two lines to page 20, line 7, that the total amount of substances of Li, Na, K, Rb and Cs in a range of 1 to 20 mol% of the magnetic layer effectively improves the signal noise ratio SNRm.

In a preferred embodiment of the present invention, the magnetic crystal particles contain Co as the main component, and further contain Pt and Cr, as recited in claim 3.

In a preferred embodiment of the present invention, at least one underlayer has a structure comprised of a metal crystal particle of Ru, Rh, Pd, Ti or Ir, as disclosed at page 14, lines 3-17 of the specification and as recited in claim 4. The underlayer preferably has a granular structure, and the grain boundaries of the underlayer preferably are comprised of a composite oxide of $SiO_2$ and at least one oxide of Li, Na, K, Rb, Cs, Ca, Sr, and Ba, as disclosed at page 14, lines 14 to 17. See claims 5 to 8.

Moriwaki et al disclose a perpendicular magnetic recording medium having a substrate and a recording layer provided on one side of the substrate made of a flexible polymer film,

optionally an undercoat layer, wherein the recording layer comprises a cobalt containing ferromagnetic metal alloy (Co-Pt-Cr) and a nonmagnetic oxide such as $SiO_2$.

Moriwaki et al disclose forming a magnetic recording layer comprising a magnetic crystal particles and a boundary layer including a single oxide of silicon oxide, which differs from the feature of the present application, in which the magnetic recording layer comprises magnetic crystal particles and the boundary layer includes composite oxides of $SiO_2$ and at least one low melting oxide of Li, Na, K, Rb and Cs.

The Examiner acknowledges that Moriwaki et al fail to explicitly teach a mixture of silicon oxide and another oxide meeting the claimed composition and mol% limitations of the present claims.

The Examiner asserts, however, that a single oxide and a mixture of silicon oxide and another oxide meeting the claimed limitations are known functional equivalents in the field of suitable oxide materials to segregate granular magnetic grains, as taught by Moriwaki et al. The Examiner particularly refers to paragraphs [0019] – [0020] of Moriwaki et al.

Thus, the Examiner has rejected claim 1 as being obvious over Moriwaki et al or Moriwaki et al and applicants' admission, because the Examiner deems that irrespective of whether the oxide is a single oxide or a mixture of silicon oxide and another oxide, the oxide is functionally equivalent to segregate granular magnetic grains.

However, as discussed above, Table 1 and the paragraph after Table 1 at page 19 of the present specification show that mixed oxides are not functionally equivalent to a single oxide in the grain boundaries of a magnetic recording layer. The addition of a low melting oxide has a drastic effect in sputtering the magnetic recording layer. As disclosed on page 7, line 24 to page 8, line 13 of the present specification, a low melting oxide such as $Li_2O$ is selected as an

additive to $SiO_2$ ,which can reduce the melting point or transition temperature of $SiO_2$. When the sputtering target contains magnetic metal components of Co-Cr-Pt and a mixed oxide of $SiO_2$ and $LiO_2$, the sputtered film has segregated magnetic crystal particles surrounded by grain boundaries comprised of mixed oxides, and the segregated magnetic crystal grains are minute particles. See page 12, last line of the present specification. That is because, since the low melting oxide, $Li_2O$, for example, reduces the melting temperature or the glass transition temperature of $SiO_2$, minute granular structures are formed without forming a supersaturated solid solution with the magnetic crystal particles. See page 13, lines 1-3 of the present specification. The effect of remarkably improving the SNR of the read/write performance is brought by the above described reasons, when the amount of additive substance is between 1 mol% to 20 mol%. See page 13, lines 10-14 of the present specification.

Moriwaki et al do not disclose or suggest a magnetic layer that is formed by using a mixed oxide of silicon and at least one oxide of Li, Na, K, Rb and Cs.

Similarly, JP H9-204651, which forms the basis for applicants' alleged admission, does not disclose or suggest a magnetic layer that is formed by using a mixed oxide of silicon and at least one oxide of Li, Na, K, Rb and Cs.

JP H9-204651 discloses a magnetic recording medium comprised of a nonmagnetic substrate, a magnetic recording layer, and a nonmagnetic electroconductive layer on the magnetic recording layer, wherein the magnetic recording layer comprises a magnetic metal particle (Co+Cr, Ni, Pt) and a nonmagnetic matrix which contains at least one oxide of Be, Mg, Ca, Sr, or Ba, and may contain $SiO_2$ or $Al_2O_3$.

JP H9-204651 discloses an example of forming a magnetic layer of Co-Pt-CaO (Example 1) or Co-Pt-$SiO_2$-MgO (Example 2). However, JP H9-204651 is silent about using a mixed

oxide of silicon oxide and at least one alkali metal oxide with Co-Pt-Cr. Accordingly, Moriwaki et al and JP H9-204651 do not disclose or suggest the use of mixed oxides of silicon oxide and an alkali metal oxide.

Further, although JP H9-204651 discloses a magnetic recording layer comprising segregated magnetic metal grains and a nonmagnetic matrix containing one of alkaline earth oxides, JP H9-204651 does not disclose a perpendicular magnetic recording medium.

Still further, with respect to the Examiner's assertion that a single oxide and a mixture of silicon oxide and another oxide meeting the claimed limitations are known functional equivalents in the field of suitable oxide materials to segregate granular magnetic grains, as taught by Moriwaki et al, and the Examiner's reference to paragraphs [0019] – [0020] of Moriwaki et al in support of this assertion, applicants point out that paragraphs [0019] to [0020] of Moriwaki et al do not refer to a mixture of silicon oxide and another oxide. Paragraph [0021] of Moriwaki et al discloses that the oxide can be one of any number of oxides, but does not disclose the use of a mixed oxide.

In view of the above, applicants submit that Moriwaki et al and applicants' alleged admission do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection..

Claim 2 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Moriwaki et al alone, or in view of applicants' admissions, as applied above, and further in view of U.S. Patent No. 5,652,054 to Kikitsu et al.

Applicants submit that Moriwaki et al, applicants' admission and Kikitsu et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

The Examiner states that Moriwaki et al and applicants' admissions do not disclose the total amount of the substance at the grain boundaries. The Examiner then asserts as follow:

> However, Kikitsu et al. teach a granular magnetic layer wherein the percentage of the magnetic substance at the grain boundary is 5% or less, preferably 0%; and wherein the percentage of the nonmagnetic oxide segregant in the magnetic grain is also 5% or less, preferably 0% (Figs. 4 - 6; col. 11, line 51 bridging col. 12, line 26; and Examples). The Examiner notes this is essentially teaching that all of the magnetic material should be in the magnetic grain, and all of the non-magnetic segregant material should be in the grain boundary region. Since the Examiner maintains that it would be obvious to add 1 - 20 mol% total of grain segregant material meeting the claimed limitations, it would also be obvious to insure that the grain boundary region would meet the claimed limitations - since all the added 1 - 20 mol% would be preferentially found at the grain boundary region per the teaching of Kikitsu et al above.

It appears to applicants that the Examiner may have misinterpreted the recitations of claim 2. Claim 2 is reciting the relationship between the Si oxide in the grain boundaries of the recording layer and the remaining oxides in the grain boundaries of the recording layer. The analysis that the Examiner sets forth, while difficult to understand, appears to have nothing to do with the relationship between the Si oxide in the grain boundaries of the recording layer and the remaining oxides in the grain boundaries of the recording layer, and merely relates to the total amount of oxides in the grain boundaries.

In order to even more clearly indicate that claim 2 is directed to the relationship between the Si oxide in the grain boundaries of the recording layer and the remaining oxides in the grain boundaries of the recording layer, applicants have amended claim 2 to recite that the ratio of total amount of substance of Li, Na, K, Rb and Cs contained at the grain boundaries in the perpendicular magnetic recording layer is no less than 1 mol% and no more than 30 mol% is "based on the total moles of the oxide of silicon and substance of Li, Na, K, Rb and Cs contained at the grain boundaries."

Kikitsu et al disclose a magnetic recording medium having a magnetic thin film made of magnetic metal grains and a nonmagnetic matrix, wherein the hardness of the nonmagnetic matrix is larger than the magnetic metal grains. Examples of magnetic metal grains are CoPt, SmCo, or CoCr, as disclosed at column 4, lines 55-57, and elements such as Cr, Nb, V, Ta can be added to these metal alloys, as disclosed at column 4, lines 61 to 64. The nonmagnetic matrix in Kikitsu et al contains compounds represented by M-G, wherein M is at least one element consisting of Si, Al, Zr, Ti, In, Sn and B, and G represents at least one of oxygen, nitrogen and carbon, as disclosed at column 5, lines 25 to 31.

Kikitsu et al do not disclose the feature of the present invention that the nonmagnetic metal matrix of the magnetic recording layer includes a composite oxide including silicon oxide and at least one low melting oxide of Li, Na, K, Rb and Cs. In addition, Kikitsu et al do not disclose a perpendicular magnetic recording medium.

In view of the above, applicants submit that Moriwaki et al, applicants' admission and Kikitsu et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

Claims 5 - 8 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Moriwaki et al, alone or in view of applicants' admissions, as applied above, and further in view of JP 2002-334424 A to Kokubu et al and U.S. Patent No. 6,696,172 B2 to Oikawa et al.

Applicants submit that Moriwaki et al, applicants' admission, Kokubu et al and Oikawa et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

The Examiner states that Moriwaki et al and applicants' admissions do not disclose an underlayer meeting the claimed limitations.

Claims 5 to 8 depends from claim 1. Accordingly, applicants submit that claims 5 to 8 are patentable for the same reasons as discussed above with respect to claim 1.

The Examiner relies on Kokubu et al and Oikawa et al for teaching the forming of a granular nonmagnetic underlayer for a perpendicular recording medium comprising Ru-$SiO_2$, as disclosed in Kokubu et al and Cr-Mo-$SiO_2$, Co-Cr-$SiO_2$ ($Al_2O_3$, SiC, TiC).

Kokubu et al disclose a magnetic recording medium, which is formed on a nonmagnetic substrate, by stacking a soft magnetic undercoat layer, an orientation control underlayer, an orientation control film, and a perpendicular magnetic recording film, in which an easy magnetization axis is oriented perpendicular to the substrate. The orientation control film consists of an alloy containing a first element and a second element, which has a solid solution limit with the first element. The first element is Ru and/or Re, while the second element is one of V, Nb, Ta and so on. The orientation control film can be formed by the first element and an oxide of Si, Zr, Hf, Ti or Al, such that the orientation control film has a granular structure.

However, the perpendicular magnetic film in Kokubu et al is formed by a transition metal layer (Co alloy) and a noble metal layer (Pt, Pd), which differs from the present application in which the perpendicular recording layer contains grain boundaries containing an oxide of silicon and at least one element of Li, Na, K, Rb and Cs.

Oikawa et al disclose a magnetic recording medium having at least a nonmagnetic under-layer and a magnetic layer. The magnetic layer has a granular structure, which includes ferromagnetic grains (Co-Cr-Pt) and nonmagnetic grain boundaries formed of metallic oxide such as $SiO_2$ or $Al_2O_3$.

Oikawa et al, however, do not disclose the feature of the present application in that at least one low melting oxide of Li, Na, K, Rb and Cs is used in the perpendicular recording layer in addition to $SiO_2$.

Further, as described on page 4, lines 18-29 of the present specification, the undercoat layer contains Ru, Ti, Rh, Pt, Pd or Ir for nonmagnetic crystal grains, and the grain boundaries can be surrounded by a mixed oxide of $SiO_2$ and at least one oxide selected from the group of oxides of Li, Na, K, Rb, Cs, Ca, Sr and Ba.

Since Kokubu et al and Oikawa et al do not disclose that mixed oxides are used in a segregated undercoat layer, and the mixed oxides in the undercoat layer contain at least one of alkali metal oxide or alkaline earth metal oxide in addition to $SiO_2$, claims 5 -8 are not disclosed or rendered obvious by Kokubu et al and Oikawa et al.

Still further, with respect to claims 6 to 8, the Examiner asserts that it would be obvious to use dual oxides in an undercoat layer because dual oxides are known functional equivalents.

As discussed above, dual oxides or mixed oxides have a remarkable effect in the present invention in sputtering to reduce the transition temperature of silicon oxide for forming more minute granular structure, and also has a remarkable effects to obtain favorable SNRm and dPW50. See Example 3 and Table 7 of the present specification which shows the effect of a mixed oxide in an underlayer. Accordingly, a mixed oxide is not the functional equivalent of a single oxide, and one of ordinary skill in the art would not have been led to the mixed oxide underlayer of claims 6 to 8.

In view of the above, applicants submit that Moriwaki et al, applicants' admission, Kikitsu et al and Oikawa et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

Claim 20 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Moriwaki et al, alone or in view of applicants' admissions, as applied above, and further in view of U.S. Patent App. No. 2002/0160232 Al to Shimizu et al.

Applicants submit that Moriwaki et al, applicants' admission, and Shimizu et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

Claim 20 depends from claim 1. Accordingly, applicants submit that the arguments that applicants set forth above for claim 1 support the patentability of claim 20.

Shimizu et al disclose a perpendicular magnetic recording medium comprising a nonmagnetic substrate, a soft magnetic undercoat film, an orientation control film and a perpendicular magnetic recording film, sequentially laminated on the substrate. The perpendicular magnetic recording film has a granular structure and it is composed of a metallic crystal particles such as CoCr, CoCrPt CoCrPtX and a grain separating material such as $SiO_2$. SiO, $Si_3N_4$, $Al_2O_3$, AlN, $TiO_2$, TiN etc.

However, Shimizu et al do not disclose the feature of the present application in that at least one low melting oxide of Li, Na, K, Rb and Cs is used in addition to $SiO_2$ as a grain separating materials in the magnetic recording layer.

In view of the above, applicants submit that Moriwaki et al, applicants' admission, and Shimizu et al do not disclose or render obvious the presently claimed invention and, accordingly, request withdrawal of this rejection.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

Sheldon I. Landsman

Sheldon I. Landsman
Registration No. 25,430

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

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